

C L A I M S

1. (Amended) A vertical heat processing apparatus comprising:

5 a process chamber defining a process field configured to accommodate a plurality of target substrates supported at intervals in a vertical direction;

10 a heating furnace surrounding the process chamber, and including an electric heater configured to heat the process field from outside the process chamber;

an electric blower configured to send a cooling gas into the heating furnace, so as to cool the process field by the cooling gas from outside the process chamber;

15 a temperature sensor configured to detect a temperature inside the process field; and

a control section configured to control the heater and the blower in accordance with detection data obtained by the temperature sensor,

20 wherein, in order to conduct temperature control to change a temperature of the process field from an initial temperature to a target temperature higher than the initial temperature but within a range of 100 to 500°C, the control section executes,

25 setting power feeding to the blower at a first feed rate to send the cooling gas, and setting power feeding to the heater at a first

supply rate, in order to heat up the process field to a predetermined temperature below the target temperature,

at a time point when the process field reaches the predetermined temperature, maintaining the power

5 feeding to the blower at the first feed rate, and decreasing the power feeding to the heater to a second supply rate lower than the first supply rate, in order to converge the process field to the target temperature, and

10 then, decreasing the power feeding to the blower to a rate lower than the first feed rate, and increasing the power feeding to the heater to a rate higher than the second supply rate, in order to maintain the process field at the target temperature.

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4. (Amended) A vertical heat processing apparatus comprising:

20 a process chamber defining a process field configured to accommodate a plurality of target substrates supported at intervals in a vertical direction;

25 a heating furnace surrounding the process chamber, and including an electric heater configured to heat the process field from outside the process chamber;

an electric blower configured to send a cooling gas into the heating furnace, so as to cool the process

field by the cooling gas from outside the process chamber;

a temperature sensor configured to detect a temperature inside the process field; and

5 a control section configured to control the heater and the blower in accordance with detection data obtained by the temperature sensor,

wherein, in order to conduct temperature control to change a temperature of the process field from an
10 initial temperature to a target temperature higher than the initial temperature but within a range of 100 to 500°C, the control section executes,

preparing one control variable to control power feeding to the heater and power feeding to the blower,
15 such that the control variable is arranged to increase the power feeding to the heater as an absolute value of the control variable increases in a positive direction, and to increase the power feeding to the blower as an absolute value of the control variable increases in a
20 negative direction,

stopping the power feeding to the blower, and setting the power feeding to the heater at a first supply rate, in accordance with the control variable, in order to heat up the process field to a
25 predetermined temperature below the target temperature,

at a time point when the process field reaches the predetermined temperature, setting the power feeding to

the blower at the first feed rate to send the cooling gas, and stopping the power feeding to the heater, in accordance with the control variable, in order to converge the process field to the target temperature, and

then, stopping the power feeding to the blower, and setting the power feeding to the heater to a rate lower than the first supply rate, in accordance with the control variable, in order to maintain the process field at the target temperature.

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5 9. The apparatus according to claim 1, wherein
the predetermined temperature is preset to be 20 to
80°C lower than the target temperature.

10. The apparatus according to claim 1, wherein
the process chamber comprises a quartz body portion

corresponding to the process field, and a quartz upper portion and a quartz lower portion present above and below the body portion, respectively, and the body portion has a wall thickness smaller than those of the upper portion and the lower portion.

11. The apparatus according to claim 10, wherein the body portion differs from the upper portion and the lower portion in wall thickness by 4 mm or less.

12. (Amended) A method of controlling a vertical heat processing apparatus,

the apparatus comprising

a process chamber defining a process field configured to accommodate a plurality of target substrates supported at intervals in a vertical direction,

a heating furnace surrounding the process chamber, and including an electric heater configured to heat the process field from outside the process chamber, and

an electric blower configured to send a cooling gas into the heating furnace, so as to cool the process field by the cooling gas from outside the process chamber, and

wherein, in order to conduct temperature control to change a temperature of the process field from an initial temperature to a target temperature higher than the initial temperature but within a range of 100 to 500°C, the method comprises:

setting power feeding to the blower at a first feed rate to send the cooling gas, and setting power feeding to the heater at a first supply rate, in order to heat up the process field to a predetermined temperature below the target temperature;

at a time point when the process field reaches the predetermined temperature, maintaining the power feeding to the blower at the first feed rate, and decreasing the power feeding to the heater to a second supply rate lower than the first supply rate, in order to converge the process field to the target temperature; and

then, decreasing the power feeding to the blower to a rate lower than the first feed rate, and increasing the power feeding to the heater to a rate higher than the second supply rate, in order to maintain the process field at the target temperature.

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15. (Amended) A method of controlling a vertical heat processing apparatus,

the apparatus comprising

a process chamber defining a process field configured to accommodate a plurality of target substrates supported at intervals in a vertical direction,

a heating furnace surrounding the process chamber,

and including an electric heater configured to heat the process field from outside the process chamber, and

an electric blower configured to send a cooling gas into the heating furnace, so as to cool the process field by the cooling gas from outside the process chamber, and

wherein, in order to conduct temperature control to change a temperature of the process field from an initial temperature to a target temperature higher than the initial temperature but within a range of 100 to 500°C, the method comprises:

preparing one control variable to control power feeding to the heater and power feeding to the blower, such that the control variable is arranged to increase the power feeding to the heater as an absolute value of the control variable increases in a positive direction, and to increase the power feeding to the blower as an absolute value of the control variable increases in a negative direction,

stopping the power feeding to the blower, and setting the power feeding to the heater at a first supply rate, in accordance with the control variable, in order to heat up the process field to a predetermined temperature below the target temperature,

at a time point when the process field reaches the predetermined temperature, setting the power feeding to the blower at the first feed rate to send the cooling

gas, and stopping the power feeding to the heater, in accordance with the control variable, in order to converge the process field to the target temperature, and

- 5 then, stopping the power feeding to the blower, and setting the power feeding to the heater to a rate lower than the first supply rate, in accordance with the control variable, in order to maintain the process field at the target temperature.

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5 20. The method according to claim 12, wherein the predetermined temperature is preset to be 20 to 80°C lower than the target temperature.

 21. (Added) The apparatus according to claim 4, wherein the predetermined temperature is preset to be
10 20 to 80°C lower than the target temperature.

 22. (Added) The apparatus according to claim 4, wherein the process chamber comprises a quartz body portion corresponding to the process field, and a quartz upper portion and a quartz lower portion present
15 above and below the body portion, respectively, and the body portion has a wall thickness smaller than those of the upper portion and the lower portion.

 23. (Added) The apparatus according to claim 22, wherein the body portion differs from the upper portion
20 and the lower portion in wall thickness by 4 mm or less.

 24. (Added) The method according to claim 15, wherein the predetermined temperature is preset to be 20 to 80°C lower than the target temperature.